GRAVITY PROBE B
PROCEDURE FOR
SCIENCE MISSION DEWAR

Measure Vatterfly Valve Leak Rate

This operation to be performed in VAFB building 1610

THIS DOCUMENT CONTAINS HAZARDOUS OPERATIONS

August 25, 2003

P1050 Rev-

Written by:

_____Date_____
Ned Calder
Cryogenics Team

Approvals:

_____Date_____
Dorrene Ross
Quality Assurance

_____Date_____
Harv Moskowitz
LMMS Safety

_____Date_____
Mike Taber
Payload Test Director

_____Date_____
Rob Brumley
Payload Technical Manager

_____Date_____
NASA/KSC Safety

Revision Record

REVISION	ECO	PAGES	DATE

Table of Contents

List of Abbreviations and Acronyms

AG-x	Gauge x of Gas Module auxiliary section
AMI	American Magnetics Inc.
ATC	Advanced Technology Center
AR	As required
Aux	Auxiliary
AV-x	Valve x of Gas Module auxiliary section
Bot	Bottom
CN [xx]	Data acquisition channel number
DAS	Data Acquisition System
DR	Discrepancy Report
EG-x	Gauge x of Gas Module exhaust section
EM	Electrical Module
ERV-x	Relief valve of Gas Module exhaust section
EV-x	Valve number x of Gas Module exhaust section
FCV	Fill Cap Valve
FIST	Full Integrated System Test
GHe	Gaseous Helium
GM	Gas Module
GP-B	Gravity Probe-B
GSE	Ground Support Equipment
GT	Guard Tank
GTVC	Guard Tank Vent Cap
GTVC-G	Guard Tank Vent Cap pressure gauge
GTVC-RV	Guard Tank Vent Cap relief valve
GTVC-V	Guard Tank Vent Cap valve
GTV-G	Guard Tank vent pressure gauge
GTV-RV	Guard Tank vent relief valve
GTV-V	Guard Tank vent valve
HX-x	Vent line heat exchanger in Gas Module
KFxx	Quick connect o-ring vacuum flange (xx mm diameter)
LHe	Liquid Helium
LHSD	Liquid Helium Supply Dewar
Liq	Liquid
LL	Liquid level
LLS	Liquid level sensor
LMMS	Lockheed Martin Missiles and Space
MT	Main Tank
MTVC	Main Tank Vent Cap
MTVC-G	Main Tank Vent Cap pressure gauge
MTVC-RV	Main Tank Vent Cap relief valve
MTVC-V	Main Tank Vent Cap valve
NBP	Normal boiling point
NASA	National Aeronautics and Space Administration
PFCG	Fill Cap assembly pressure Gauge
PFM	Pump equipment Flow Meter
PG-x	Gauge x of Pump equipment
PRT	Platinum Resistance Thermometry
psi	pounds per square inch
psig	pounds per square inch gauge
PTD	Payload Test Director
PV-x	Valve x of the Pump equipment
QA	Quality Assurance
QE	Quality Engineer
RGA	Residual Gas Analyzer
SMD	Science Mission Dewar
STV	SMD Thruster vent Valve
SU	Stanford University
SV-x	SMD Valve number x
TG-x	Gauge x of Utility Turbo System
TV-x	Valve x of Utility Turbo System
UTS	Utility Turbo System
VAFB	Vandenberg Air Force Base
VCP-x	Vent cap pressure gauge
VCRV-x	Vent cap relief valve
VCV-x	Vent cap valve
VDC	Volts Direct Current
VF-x	Liquid helium Fill line valve
VG-x	Gauge x of Vacuum Module
VM	Vacuum Module
VV-x	Valve x of Vacuum Module
VW-x	Valve x of Dewar Adapter

LV-x	Large Vatterfly-x

A. SCOPE

This procedure describes the steps necessary to measure the leak rates on all 6 vatterfly valves. Note that LV-1, LV-2, and EV-1 are completed first followed by the remaining EV's. The steps include:

1. Connect GSE to first three vatterfly valve covers
2. Leak check all connections
3. Set-up temperature measurement equipment
4. Measure volume of plumbing and backfill caps
5. Measure leak rate over period of 2 days
6. Evacuate caps and close cover valves

Based on successful leak rate measurements, an option is provided to remove the Vatterfly valve covers and/or install the associated filters. Note that filters are only installed on the two LV valves.

This procedure will be accomplished in Building 1610.

The hazardous operation in this procedure is the handling of liquid nitrogen to service the leak detector.

Note:
This procedure will need to be run twice in order to measure the leak rate on all 6 Vatterfly valves.

B. SAFETY

B.1. Potential Hazards

Personal injury and hardware damage can result during normal positioning, assembly and disassembly of hardware.

Liquid helium used in the SMD represents a hazardous material for the personnel involved in the operations. Cryogenic burns can be caused by contact with the cold liquid or gas, high pressures can result if boiling liquid or cold gas is confined without a vent path, and asphyxiation can result if the vent gas is allowed to accumulate.

The SMD Safety Compliance Assessment, document GPB-100153C and the Missile System Prelaunch Safety Package LM/P479945 discuss the safety design, operating requirements and the hazard analysis of the SMD.

B.2. Mitigation of Hazards

B.2.1. Lifting hazards

There are no lifting operations in this procedure

B.2.2. Cryogenic Hazards

In VAFB building 1610, there may be an oxygen deficiency monitor that alarms when the oxygen level is reduced to 19.5%. In addition, the GP-B cryogenic team provides an oxygen deficiency monitor that alarms when the oxygen level is reduced to 19.5%. Appropriate action(s) to be taken in the event of oxygen deficiency monitor alarming at 19.5% (evacuation, safety verification of acceptable O2, etc) Additional temperature and pressure alarms, provided by the DAS, warn of potential over-pressure conditions. Emergency vent lines are installed over the four burst disks to direct any flow to an outside area.

Only authorized and trained personnel are allowed in VAFB facilities without escort. All personnel working on platforms at a height 30 inches or more off the floor are required to have an approved air tank (emergency life support apparatus ELSA) within easy reach. Note that tank need not be kept available when working from ladder. In the unlikely event of a large Lhe spill all employees have been instructed to evacuate the room and proceed to designated fallback area Bldg 1605, and contact NASA safety.

The following additional requirements apply to all personnel involved directly in cryogenic operations. Gloves that are impervious to liquid helium and liquid nitrogen are to be worn whenever the possibility of splashing or impingement of high-velocity cryogens exists or when handling equipment that has been cooled to cryogenic temperatures. Protective clothing, non-absorbent shoes and full-face shields with goggles/glasses are to be worn whenever the possibility of splashing cryogens exists.

B.2.3. Other Hazards

All tools or other items used with the potential to damage the SMD or Probe shall be tethered.

B.3. Mishap Notification

B.3.1. Injury

In case of illness/injury requiring EMERGENCY medical treatment, **DIAL 911.**

B.3.2. Hardware Mishap

In case of an accident, incident, or mishap, notification is to proceed per the procedures outlined in Lockheed Martin Engineering Memorandum EM SYS229 and Stanford University GP-B P0879. Additionally, VAFB NASA Safety and 30th Space Wing Safety will be notified as required.

B.3.3. Contingency Response

Responses to contingencies (e.g., power failure) are listed in Appendix 3.

C. QUALITY ASSURANCE

C.1. QA Notification

The NASA representative and SU QA shall be notified 24 hours prior to the start of this procedure. Upon completion of this procedure, the QE Manager will certify his/her concurrence that the effort was performed and accomplished in accordance with the prescribed instructions by signing and dating in the designated place(s) in this document.

C.2. Red-line Authority

Authority to red-line (make minor changes during execution) this procedure is given solely to the PTD or his designate and shall be approved by the QA Representative. Additionally, approval by the Payload Technical Manager shall be required, if in the judgement of the PTD or QA Representative, experiment functionality may be affected. Within hazardous portions of this procedure, all steps shall be worked in sequence. Out-of-sequence work or redlines shall be approved by NASA Safety prior to their performance.

C.3. Discrepancies

A Quality Assurance Representative designated by D. Ross shall review any discrepancy noted during this procedure, and approve its disposition. Discrepancies will be recorded in a D-log or a DR per Quality Plan P0108. Any time a procedure calls for verification of a specific configuration and that configuration is not the current configuration, it represents a discrepancy of one of three types. These types are to be dealt with as described below.

1. If the discrepancy has minimal effect on procedure functionality (such as the state of a valve that is irrelevant to performance of the procedure) it shall be documented in the procedure, together with the resolution. Redlines to procedures are included in this category.
2. If the discrepancy is minor and affects procedure functionality but not flight hardware fit or function, it shall be recorded in the D-log. Resolution shall be in consultation with the PTD and approved by the QA representative.
3. All critical and major discrepancies, those that effect flight hardware fit or functions, shall be documented in a D-log and also in a Discrepancy Report, per P0108.

D. TEST PERSONNEL

D.1. Personnel Responsibilities

The performance of this procedure requires a minimum complement of personnel as determined by the Test Director. The Test Director is the designated signer for the “witnessed by” sign-off located at the end of each procedure. The person in charge of the operation (Test Director or Test

Engineer) is to sign the "completed by" sign-off. The Test Director will perform Pre-Test and Post-Test Briefings in accordance with P0875 "GP-B Maintenance and Testing at all Facilities." Checklists will be used as directed by P0875

D.2. Personnel Qualifications

The Test Director must have a detailed understanding of all procedures and facility operations and experience in all of the SMD operations. Test Engineers must have SMD Cryogenic operations experience and an understanding of the operations and procedures used for the cryogenic servicing/maintenance of the Dewar.

D.3. Required Personnel

The following personnel are essential to the accomplishment of this procedure:

FUNCTIONAL TITLE	NUMBER	AFFILIATION
Test Director/Test Engineer	1	Stanford
GP-B Quality Assurance	1	Stanford
NASA Safety Rep	1	SFAO or ANALEX

E. REQUIREMENTS

There are no lifting operations in this procedure

E.1. Hardware/Software Requirements

E.1.1. Commercial Test Equipment

No commercial test equipment is required for this operation.

E.1.2. Ground Support Equipment

The Ground Support Equipment includes the Gas Module, the Electrical Module. The Gas Module provides the capability to configure vent paths, read pressures and flow rates, and pump and backfill vent lines. The Pump Module provides greater pumping capacity than the Gas Module, together with additional flow metering capabilities. The vent output of the Gas Module flows through the Pump Module. The Electrical Module contains the instruments listed in Table 1, and provides remote control of valves in the Gas Module, Pump Module, and SMD.

E.1.3. Computers and Software:

The Data Acquisition System (DAS) is required for this procedure. The DAS reads and displays pressures, temperatures, and flow rates and monitors critical parameters. No additional computers or software are required.

E.1.4. Additional Test Equipment

Description
Helium leak detector: Calibrated. Leak:____ Cal Due Date:_____

MKS 670B readout unit Cal Due Date:_____
MKS 274 multiplexer
3 MKS 690A pressure sensors Cal Due Date:_____
1 Varian cermi cell 1000 torr cap gauge Cal Due Date:_____
3 MKS 690A pressure sensors Cal Due Date:_____

E.1.5. Additional Hardware

Description
Assorted clean plumbing
Calibrated Volume
4 liter thermos

E.1.6. Tools

Description
N/A

E.1.7. Personnel Protective Equipment

1. Cryogenic safety gloves and apron
2. Face Shield
3. Goggles/Glasses
4. Non-absorbent shoes

E.1.8. Expendables

Description	***Quantity***	***Mfr./Part No.***
Isopropyl	AR	N/A
99.999% pure gaseous helium	AR	N/A
Vacuum Grease	AR	Apeizon N Dow Corning High Vacuum Grease

E.2. Instrument Pretest Requirements

The GSE instruments required to perform this procedure are listed in Table 1, together with their serial numbers, where available. Instruments that are required to have current calibrations are indicated in the Cal-Required column. Instruments that do not require calibration are those not used to verify performance requirements and are not connected to flight instrumentation. The status column is to be filled in with the due date of the instrument calibration sticker and verified to be in calibration by QE or QE designee.

Table 1. Required Instrumentation and Calibration Status

No.	*Location*	*Description*	*User Name*	*Serial No.*	*Cal Required*	*Status Cal due date*
1	DAS	Power Supply, H-P 6627A	-	3452A01975	Yes	
2	DAS	Power Supply, H-P 6627A	-	3452A01956	Yes	
3	DAS	Data Acquisition/Control Unit H-P 3497A	-	2936A245539	No	-
4	DAS	Digital Multimeter H-P 3458A	-	2823A15047	Yes	
5	EM	Vacuum Gauge Controller Granville-Phillips Model 316	EG-1a, -1b	2827	No	-
6	EM	Vacuum Gauge Controller Granville-Phillips Model 316	AG-2a, -2b	2826	No	-
7	EM	Vacuum Gauge Controller Granville-Phillips Model 316	EG-3	2828	No	-
8	EM	MKS PDR-C-2C	EG-2, FCG	92022108A	No	-
9	EM	Flow meter – Matheson 8170	EFM-1	96186	No	-
10	EM	Flow meter totalizer Matheson 8124	EFM-1	96174	No	-
11	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Main Tank	96-409-11	No	-
12	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Guard Tank	96-409-10	No	-
13	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Well	96-409-9	No	-
14	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Axial Lock	96-409-12	No	-
15	EM	Pressure Controller – MKS 152F-92	EV-7a, -7b	96203410A	No	-
16	EM	Power Supply HP 6038A	H08D Tank Heater	96023407A	Yes	
17	EM	Power Supply HP 6038A	H09D Tank Heater	3511A-13332	Yes	
18	EM	Power Supply HP 6038A	RAV Power Supply	3329A-12486	Yes	
19	EM	Vac Ion Pump power supply Varian 929-0910, Minivac	SIP	5004N	No	-
20	EM	Flow meter totalizer Veeder-Root	PFM-1	576013-716	No	-
21	GM	Pressure Gauge, Heise	AG-1	CC-122077	No	-
22	GM	Pressure Gauge, Marshall Town	AG-3	N/A	No	-
23	GM	Main Tank Heat Exchanger: a) Thermocouple, b) Current meter, c) Temperature set point controller	-	C-19950	No	-
24	GM	Guard Tank Heat Exchanger: a) Thermocouple, b) Current meter, c) Temperature set point controller	-	C-09920	No	-
25	VM	Vacuum Gauge readout, Granville-Phillips 316	VG-3 VG-4	2878	No	-
26	VM	Vacuum Gauge readout, Granville-Phillips 360	VG-1, VG-2 VG-5	96021521	No	-

E.3. Configuration Requirements

E.3.1. Main Tank
There are no special requirements for the Main Tank

E.3.2. Guard Tank
There are no special requirements for the Guard-Tank.

E.3.3. Well
The Well is always evacuated.

E.3.4. Vacuum Shell

There is no requirement for the vacuum shell pressure.

E.3.5. Alarm System

1. The DAS alarm system must be enabled and contain the following alarm set-points:
    a. Top of the lead bag temperature (CN 40) set at $T \leq 6.0K$.
    b. Top of lead bag temperature set (CN 41) at $T \leq 6.0$ K.
    c. Relative Guard Tank Pressure (CN 46) set at $P \geq 30$ torr.

E.3.6. GSE

1. GSE cabling must be connected between the SMD and the Electrical Module (P/N 5833812) and between the SMD and the Data Acquisition System (P/N 5833811).
2. Leak-tight covers are installed on the six Vatterfly valves, V1 – V4 and LV1, LV2.

F. REFERENCE DOCUMENTS

F.1. Drawings

Drawing No.	***Title***
LMMS-5833394	Instrumentation Installation

F.2. Supporting documentation

Document No.	***Title***
LMMC-5835031	GP-B Magnetic Control Plan
GPB-100153C	SMD Safety Compliance Assessment
LM/P479945	Missile System Prelaunch Safety Package
SU/GP-B P0141	FIST Emergency Procedures
LMSC-P088357	Science Mission Dewar Critical Design Review
SU/GP-B P0108	Quality Plan
LMMS GPB-100333	Science Mission Dewar Failure Effects and Causes Analysis
SU/GP-B P059	GP-B Contamination Control Plan
EM SYS229	Accident/Mishap/Incident Notification Process
EWR 127-1	Eastern and Western Range Safety Requirements
KHB 1710.2 rev E	Kennedy Space Center Safety Practices Handbook

F.3. Additional Procedures

Document No.	*Title*
SU/GP-B P0879	Accident/Incident/Mishap Notification Process
SU/GP-B P1015	Connect Vacuum Module to SMD
SU/GP-B P0875	GP-B Maintenance and Testing at all Facilities

Operation Number:_____

Date Initiated:_____

Time Initiated:_____

G. OPERATIONS

G.1. Pre-Operations Verifications

- Verify SU QA notified.

  Record: Individual notified _____,

  Date/time _____/_____.
- Verify NASA representative notified.

  Record: Individual notified _____,

  Date/time _____/_____.
- Verify NASA safety representative notified.

  Record: Individual notified _____,

  Date/time _____/_____.
- Verify completion of the Pre-Operations Checklist (Appendix 1).
- Verify proper operation of GP-B Cryogenic Team oxygen monitor
- Record calibration due dates in Table 1 and section E.1.4

QA Witness:_____

G.2. Initial Operations

G.2.1. Record serial number on helium bottle/s.

1. _____ 2._____ 3. _____
4. _____ 5 _____ 6. _____

G.2.2. Verify Helium cylinder/s contents have been tested and record operation number.

Opt Number:_____

QA Witnesss:_____

G.3. Record Vatterfly Valves to be tested and Connect Test Hardware to Appropriate Vatterfly Valves

G.3.1. Record Vatterfly Valves to be tested:

1. _____
2. _____
3. _____

G.3.2. Attach Vatterfly test hardware (lines, valves, and gauges) to Utility Turbo System (UTS) as indicated in figure 1

1. Ensure all pumping lines, fittings and valves are cleaned for vacuum
2. Ensure calibrated volume clean for vacuum
3. Clean room gloves must be worn while handling vacuum clean hardware
4. Record approximate lengths of lines and fittings used on figure 1

G.3.3. Record the location of gauges and valves relative to their associated Vatterfly Cover

1. CV-1/G-1/V-1:_____
2. CV-2/G-2/V-2:_____
3. CV-3/G-3/V-3:_____

G.3.4. Ensure open valves V-1, V-2, V-3, V-4, and V-5

G.4. **Leak Check All Connections**

G.4.1. Place UTS Valve Interlock switch in the "over-ride" position.

G.4.2. Turn on Vane Pump and Converter

G.4.3. Push the red reset button

G.4.4. Open the foreline valve TV-2.

G.4.5. Slowly open TV-4

G.4.6. Push the sensor button on the vacuum gauge display so that the "Pir" annunciator shows.

G.4.7. When the pressure on the Piriani gauge reads $<1\times10^{-2}$ torr, push the start button on the turbo controller.

G.4.8. When the "Normalbetrieb" light comes on, close TV-4 and open the UTS Gate Valve TV-1

G.4.9. Switch the Valve Interlock switch to the "protected" position.

G.4.10. Push the button on the vacuum gauge readout so that the "Hi-Vac" annunciator shows, and push the emis button to turn on the cold cathode gauge, TG-1

WARNING

This is a hazardous operation. When filling the nitrogen trap in the leak detector, wear cryogenic safety apron, gloves, face shield with goggles/glasses, and non-absorbent shoes. Failure to comply may result in personal injury.

G.5. **Leak Check Pumping Line**

G.5.1. Ensure the area warning light is changed to Amber

G.5.2. Ensure a controlled area of 15 feet is established

G.5.3. Ensure all nonessential personnel are clear of controlled area.

G.5.4. Make a PA announcement that a hazardous task is about to begin

G.5.5. Start Leak detector and fill LN2 trap

G.5.6. Verify operation of leak detector

1. Record calibrated leak S/N #:_____ and Cal due date:_____
2. Record calibrated leak rate:_____
3. Record measured leak rate:_____
4. Verify G.4.1.2 and G.4.1.3 are within 5% of each other.

Note:
The hazardous operation is now complete. Make PA announcement stating that the hazardous operation is now complete. Ensure area warning light turned to green and disband controlled area.

G.5.7. Attach leak detector to UTS TV-3

G.5.8. Leak check all plumbing up to closed TV-3

G.5.9. Leak check all Vatterfly test hardware

1. Slowly open TV-3 and then close TV-2
2. When leak detector is on the 10^{-7} range, leak check all plumbing and connections between UTS and vatterfly valve covers
3. Record initial leak rate:_____
4. Record final leak rate:_____
5. Verify no leaks detected
6. Open TV-2
7. Close TV-3

G.5.10. Slowly open valves CV-1, CV-2 and CV-3 while maintaining TG-1 < 5*10-4 torr

G.5.11. Leak check vatterfly valve covers

1. Slowly open TV-3 and then close TV-2
2. When leak detector is on the 10^{-7} range, leak check all Vatterfly Valve Covers
3. Record initial leak rate:_____
4. Record final leak rate:_____
5. Verify no leaks detected
    a. If any leaks are detected, note in d-log and consult with Payload Test Director
6. Open TV-2
7. Close TV-3

G.5.12. Pump until TG-1 reads <2*10-6 torr

G.5.13. Record the following

1. TG-1:_____

Note:
Before recording any values for G-1, G-2 or G-3, ensure the gauge has had ample time to warm up appropriately (~3 hours)

2. G-1:_____
3. G-2:_____
4. G-3:_____
5. G-4:_____

G.5.14. Close CV-1, CV-2, CV-3, V-1, V-2, V-3, V-4, V-5

QA Witness:_____

G.6. Configure Temperature Measurement Test Equipment on Vatterfly Valve covers

G.6.1. Ensure PRT connectors labeled as PRT-1, PRT-2, and PRT-3

G.6.2. Install PRT-1 on to Vatterfly Valve Cover (V-1, CV-1, G-1) and connect it to PRT readout #1

1. Record Vatterfly Valve:_____

G.6.3. Install PRT-2 on to Vatterfly Valve Cover 2 (V-2, CV-2, G-2) and connect it to readout PRT #2

1. Record Vatterfly Valve:_____

G.6.4. Install PRT-3 on to Vatterfly Valve (V-3, CV-3, G-3) and connect it to readout PRT #3

1. Record Vatterfly Valve:_____

G.6.5. Install PRT-4 on to calibrated and connect it to readout PRT #4

G.6.6. Record the following temperatures

1. PRT-1:_____
2. PRT-2:_____
3. PRT-3:_____
4. PRT-4:_____

QA Witness:_____

G.7. **Fill Vatterfly Valve Covers with Helium Gas and Measure Volume**

G.7.1. Before recording any values for G-1, G-2 or G-3, ensure the gauge has had ample time to warm up appropriately (~3 hours)

G.7.2. Close/ Ensure closed CV-1, CV-2, CV-3, V-1, V-2, V-3, TV-1, and TV-4

G.7.3. Ensure open V-4 and V-5

G.7.4. Open TV-5 and fill calibrated volume to ~950 torr as read on G-4 and then close TV-5

G.7.5. Close V-5

G.7.6. Record PRT-4:_____K

G.7.7. Record G-4:_____torr

G.7.8. Close V-4

G.7.9. Open V-5 and evacuate plumbing to <25mTorr, then close V-5

G.7.10. Open V-4

G.7.11. Record G-4:_____torr

G.7.12. Open CV-1

G.7.13. Open V-1 and back fill Vatterfly cap to ~760 +/ 20 torr and then close V-1

1. Record Date/Time:_____/_____

G.7.14. Wait until G-1 and G-4 stabilize and then record:

1. Record G-1:_____torr
2. Record G-4:_____torr
3. PRT-4:_____

G.7.15. Open V-5

G.7.16. Place UTS Valve Interlock switch in the "over-ride" position.

G.7.17. Verify on/Turn on Vane Pump and Converter

G.7.18. Push the red reset button

G.7.19. Verify Open/ Open the foreline valve TV-2.

G.7.20. Slowly open TV-4

G.7.21. Push the sensor button on the vacuum gauge display so that the "Pir" annunciator shows.

G.7.22. When the pressure on the Piriani gauge reads $<1\times10^{-2}$ torr, push the start button on the turbo controller.

G.7.23. When the "Normalbetrieb" light comes on, close TV-4 and open the UTS Gate Valve TV-1

G.7.24. When TG-1 < 5*10^-6 torr close TV-1 and TV-2

G.7.25. Press Stop on Turbo controller

G.7.26. Ensure open V-4 and V-5

G.7.27. Open TV-5 and fill calibrated volume to ~950 torr as read on G-4, then close TV-5

G.7.28. Close V-5

G.7.29. Record PRT-4:_____

G.7.30. Record G-4:_____torr

G.7.31. Close V-4

G.7.32. Open V-5 and evacuate plumbing to <25mTorr, then close V-5

G.7.33. Open V-4

G.7.34. Record G-4:_____torr

G.7.35. Open CV-2

G.7.36. Open V-2 and backfill cap to 760 +/- 20 torr as read on G-2 and then close V-2

1. Record Date/Time:_____

G.7.37. Record G-2:_____torr

G.7.38. Record G-4:_____torr

G.7.39. Record PRT-4:_____

G.7.40. Open V-5

G.7.41. Place UTS Valve Interlock switch in the "over-ride" position.

G.7.42. Verify On/Turn on Vane Pump and Converter

G.7.43. Push the red reset button

G.7.44. Open the foreline valve TV-2.

G.7.45. Slowly open TV-4

G.7.46. Push the sensor button on the vacuum gauge display so that the "Pir" annunciator shows.

G.7.47. When the pressure on the Piriani gauge reads $<1\times10^{-2}$ torr, push the start button on the turbo controller.

G.7.48. When the "Normalbetrieb" light comes on, close TV-4 and open the UTS

Gate Valve TV-1

G.7.49. When TG-1 < 5*10^-6 torr close TV-1 and TV-2

G.7.50. Press Stop on Turbo controller

G.7.51. Ensure open V-4 and V-5

G.7.52. Open TV-5 and fill calibrated volume to ~950 torr as read on G-4 and then close TV-5

G.7.53. Close V-5

G.7.54. Record PRT-4:_____

G.7.55. Record G-4:_____torr

G.7.56. Close V-4

G.7.57. Open V-5 and evacuate plumbing to <25mTorr, then close V-5

G.7.58. Open V-4

G.7.59. Record G-4:_____torr

G.7.60. Open CV-3

G.7.61. Open V-3 and backfill cap to ~760 torr +/- 20 Torr and then close V-3

G.7.62. Record G-3 :_____torr

G.7.63. Record G-4:_____torr

G.7.64. Record PRT-4:_____

G.7.65. Ensure V-1, V-2 and V-3 closed

G.7.66. Ensure CV-1, CV-2 and CV-3 open

G.7.67. Begin recording data every 15 minutes in data sheet at the end of the procedure

G.7.68. Continue recording data for 48 hours

Note:
Data should be entered into a spreadsheet and analyzed continuously throughout the test. Based on the stabilities of the measurement equipment, 24hrs should produce sufficient results to meet the component qualification levels.

QA Witness:_____

Note:
The following two sections give the Test Director an option of either evacuating the covers and removing the test hardware or removing the covers and install the associated filters where necessary. Concurrence must be given by Test Director, the Payload Test Director and the Payload Technical Manager before any Vatterfly Valve cover is removed. Phone concurrence is acceptable.

G.8. **Option: Remove Test Hardware, Remove Vatterfly Valve Covers, and install Vatterfly Filters**

Note:
Filters are only installed on the two LV valves

G.8.1. Based on the data collected in this procedure, record the inferred leak rates for the three Vatterfly valves tested

1. Valve:_____Leak Rate:_____
2. Valve:_____Leak Rate:_____
3. Valve:_____Leak Rate:_____

G.8.2. Ensure concurrence given to proceed

1. Test Director:_____
2. Payload Test Director:_____
3. Payload Technical Manager:_____
4. SU QA:_____

G.8.3. If leak measurements have been performed on the two LV valves, ensure LM mechanical team prepared to run HPF 025

G.8.4. Remove test hardware

1. If using test hardware again, maintain cleanliness and leave plumbing lines and gauges manifolded together.
2. Install VCR plug in open ends of lines

G.8.5. Remove Vatterfly Valve covers and inspect Vat valves

G.8.6. Request LM mechanical team perform HPF 025

1. Record Opt number:_____

QA Witness:_____

G.9. **Option: Evacuate Vatterfly Valve Covers and Remove Test Hardware**

G.9.1. Open V-1, V-2, V-3, V-4 and V-5

G.9.2. Place UTS Valve Interlock switch in the "over-ride" position.

G.9.3. Turn on Vane Pump and Converter

G.9.4. Push the red reset button

G.9.5. Open the foreline valve TV-2.

G.9.6. Slowly open TV-4

G.9.7. Push the sensor button on the vacuum gauge display so that the "Pir" annunciator shows.

G.9.8. When the pressure on the Piriani gauge reads $<1\times10^{-2}$ torr, push the start button on the turbo controller.

G.9.9. When the "Normalbetrieb" light comes on, close TV-4 and open the UTS Gate Valve TV-1

G.9.10. Pump until TG-1 < 5*10-6 torr

G.9.11. Close CV-1, CV-2, CV-3, V-1, V-2, V-3 and V-4

G.9.12. Close TV-1 and TV-2

G.9.13. Press Stop on Turbo Controller and open TV-5 to spin down turbo pump

G.9.14. Open TV-5 and backfill plumbing to 760 torr

G.9.15. Remove all plumbing lines, valves and gauges

1. Clean room gloves must be worn when handling all vacuum clean lines.
2. Cap all plumbing lines, valves and gauges and then double bag in clean room bags

G.9.16. Install plugs into CV-1, CV-2 and CV-3

QA Witness:_____

G.10. **Final Verifications**

G.10.1. Verify completion of post-operations checklist.

Completed by:_____

Completed by:_____

Witnessed by:_____

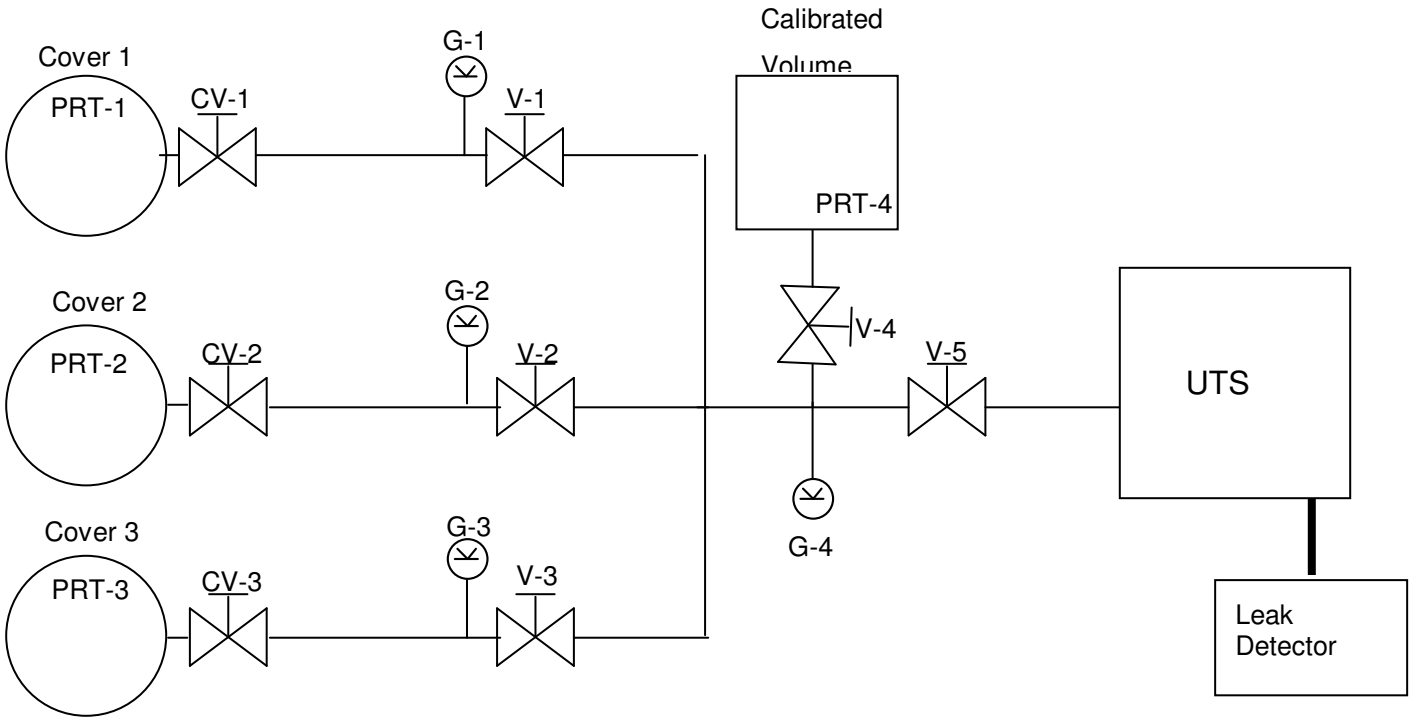
Date: _____

Time:_____

Quality Manager_____**Date**_____

Payload Test Director_____**Date**_____

Figure 1


Cover 1
PRT-1
CV-1
G-1
V-1
Calibrated
Volume
PRT-4
Cover 2
PRT-2
CV-2
G-2
V-2
V-4
V-5
UTS
Cover 3
PRT-3
CV-3
G-3
V-3
G-4
Leak
Detector

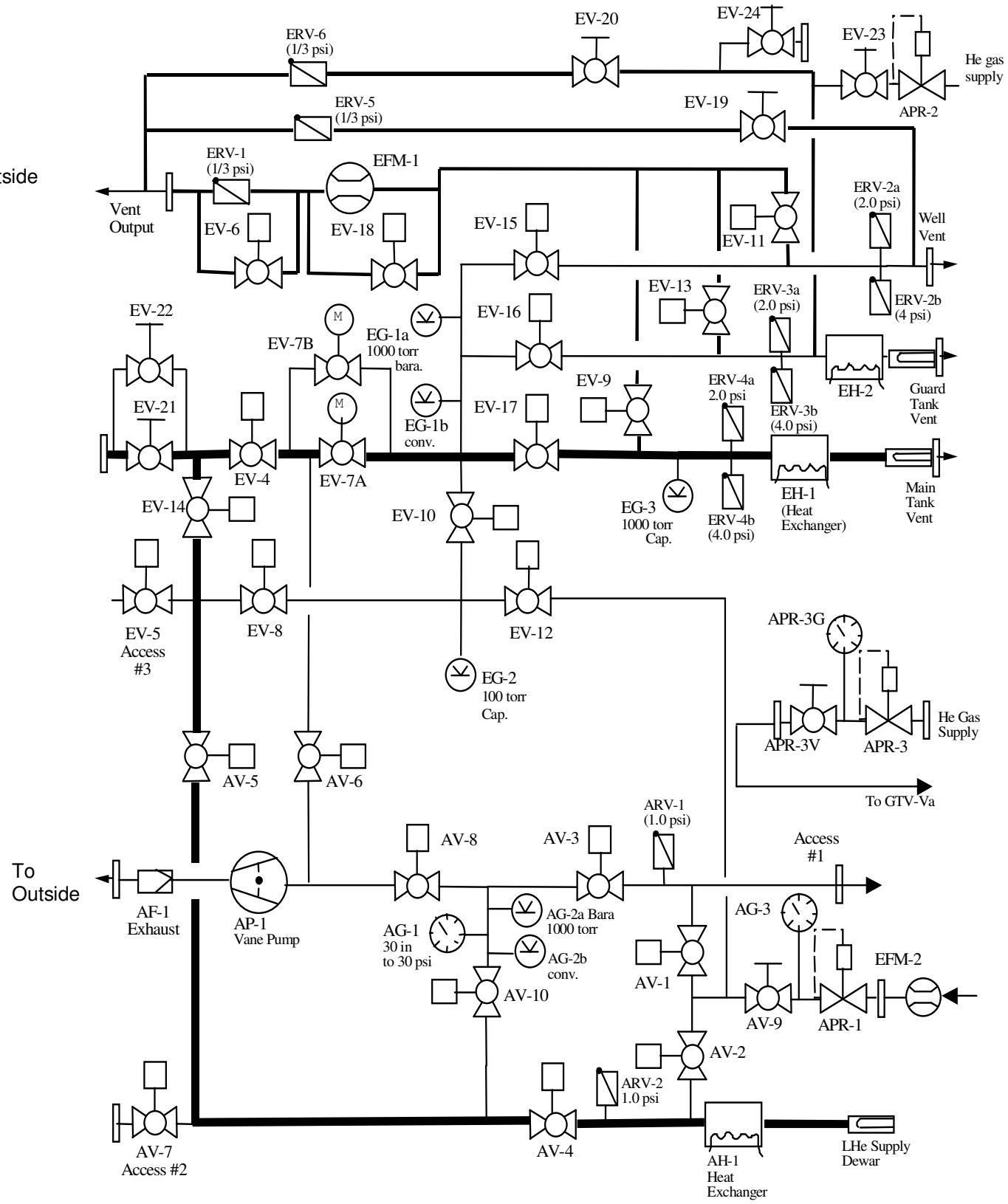


Figure 2. Gas Module

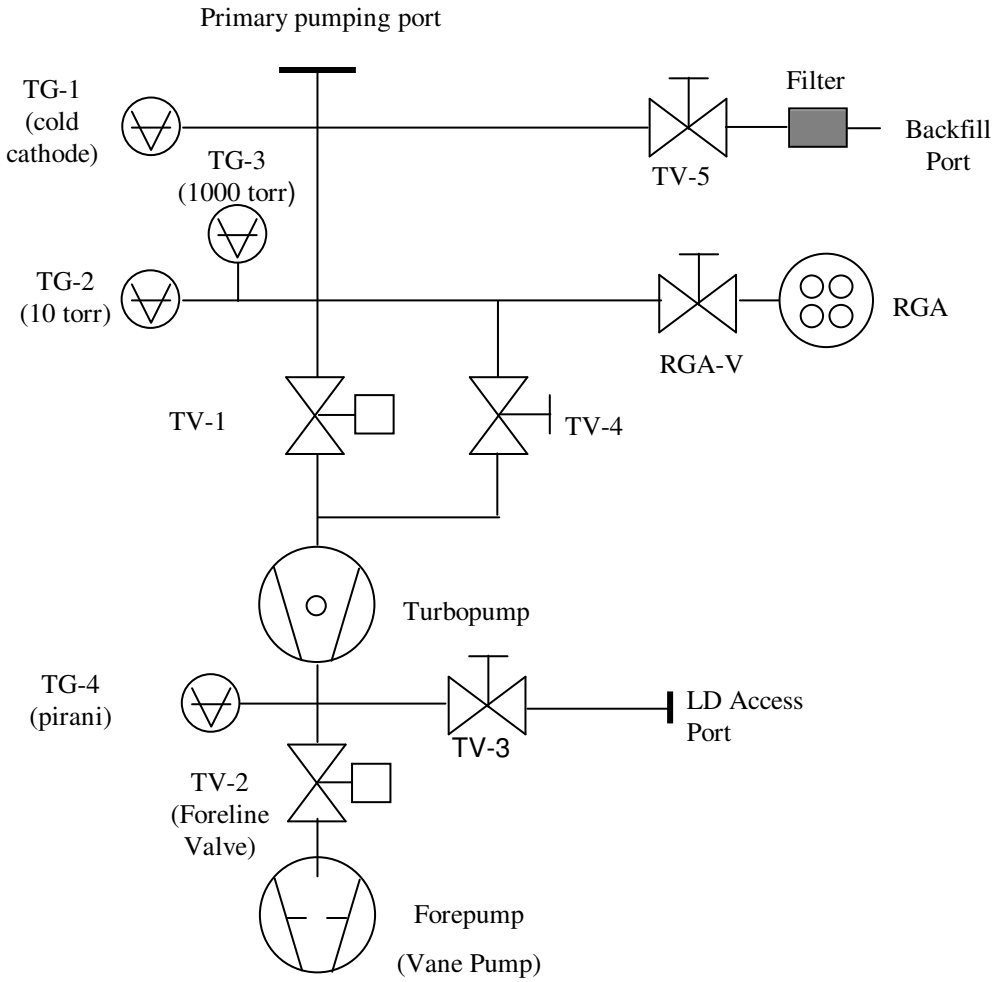


Figure 4. Schematic diagram of Utility Pumping System (UTS)

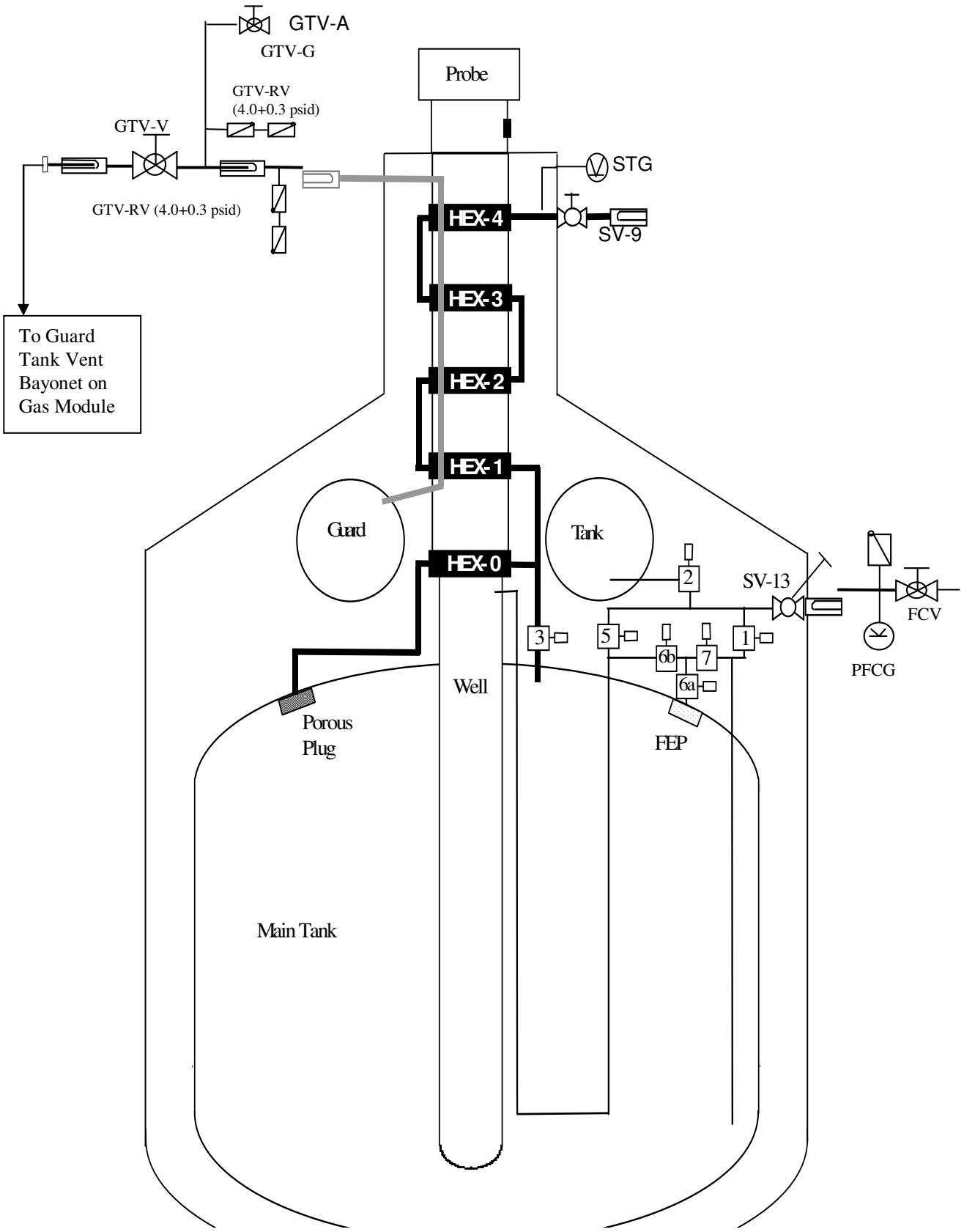


Figure 5. Schematic of Science Mission Dewar plumbing.

Appendix 1 **Pre Operations Checklist**

DATE	CHECKLIST ITEM	COMPLETED	REMARKS
	1. Verify the test procedure being used is the latest revision.		
	2. Verify all critical items in the test are identified and discussed with the test team.		
	3. Verify all required materials and tools are available in the test area.		
	4. Verify all hazardous materials involved in the test are identified to the test team.		
	5. Verify all hazardous steps to be performed are identified to the test team.		
	6. Verify each team member is certified and knows their individual responsibilities.		
	7. Confirm that each test team member clearly understands that he/she has the authority to stop the test if an item in the procedure is not clear.		
	8. Confirm that each test team member clearly understands that he/she must stop the test if there is any anomaly or suspected anomaly.		
	9. Notify management of all discrepancy reports or d-log items identified during procedure performance. In the event an incident or major discrepancy occurs during procedure performance management will be notified immediately.		
	10. Confirm that each test team member understands that there will be a post-test team meeting.		
	Team Lead Signature: _____		

Appendix 2 **Post Operations Checklist**

DATE	CHECKLIST ITEM	COMPLETED	REMARKS
	1. Verify all steps in the procedure were successfully completed.		
	2. Verify all anomalies discovered during testing are properly documented.		
	3. Ensure management has been notified of all major or minor discrepancies.		
	4. Ensure that all steps that were not required to be performed are properly identified.		
	5. If applicable sign-off test completion.		
	Team Lead Signature: _____		

Appendix 3– **Contingency Responses**

Condition	Circumstance	Response
Temperature limits (CN 1 or 28) exceeded	Any time	Promote MT venting: Open SV-9 and/ or EV-9 as appropriate to increase MT venting
Burst disk rupture (MT/GT)	Any time	Evacuate room
Vatterfly valve cover below atmospheric	Any time	Consult Payload Test Director and Payload Technical Manager
Main Tank or Guard Tank liquid level falls below alarm limit	Any time	Configure Dewar and Fill as appropriate
Oxygen Monitor Alarm	Anytime	Evacuate Room
Liquid Nitrogen Spill	Anytime	Clear area until all spilled liquid has evaporated
High boiloff rate	Any time	Reduce pressure in vatterfly caps: Adjust UTS valving so as to begin pumping on caps

Vatterfly Valve Leak Rate Measurement Data Sheet

Date/Time	G-1	G-2	G-3	G-4	PRT-1	PRT-2	PRT-3